Executive Summary

ES.1 Introduction

This Risk Assessment (RA) was conducted to evaluate the potential for adverse impacts to human health and the environment associated with the potential exposure to residual constituents present at the former DuPont Works Explosives manufacturing site (Site) located in Pierce County, Washington. Residual constituents are those constituents that remain in the soil, or other media, after the explosives manufacturing facility was decommissioned and after interim source removal of soil and debris. This Executive Summary summarizes the methods, inputs, and assumptions used to determine Site-specific cleanup and remediation levels, and identifies areas on the Site that are not in compliance with these standards, and that will therefore be addressed in the Feasibility Study (FS). The RA was conducted in accordance with a Consent Decree, effective July 1991, between the lead agency, the Washington State Department of Ecology (Ecology), and the principal responsible parties, Weyerhaeuser Corporation (Weyerhaeuser) and E.I duPont de Nemours and Company (DuPont).

The Site initially consisted of two parcels and is located within the limits of the City of DuPont, Pierce County, Washington (See Figure ES-1). Parcel 2 was remediated and is now used for industrial purposes. Parcel 1, which is the focus of this RA, is located in the western part of the City of DuPont.

ES.2 Background Information

Two risk assessment reports for the Site were written prior to this RA. In 1989, a preliminary draft RA was completed, and a second RA was completed in 1994. The 1994 draft RA underwent review cycles with Ecology and others, but was never finalized.

The RA presented here incorporates comments received on the 1994 Draft RA, and agreements and actions completed at the Site subsequent to that report. This RA was prepared in accordance with the Model Toxics Control Act (MTCA) Cleanup Regulation, Chapter 173-430 WAC. Using MTCA guidance, risk-based cleanup and remediation levels were developed for each constituent considering future land use, exposed populations, exposure pathways, and toxicity information, using prescribed noncancer and cancer risk goals. This was accomplished through completion of the following three tasks:

1. Data Evaluation, Reduction, and Screening.

2. Identification/Development of Cleanup Standards.

3. Comparison of Site Media Concentrations to Cleanup Standards.

The results of each of these tasks are presented in the following sections.

ES.3 Data Evaluation, Reduction, and Screening

Future land uses of the Site, evaluation units (EUs), media of concern, and a preliminary list of constituents of potential concern (COPCs), were identified in this task.

ES.3.1 Future Land Use

Based on a restrictive covenant, and in accordance with the Final Environmental Impact Statement, future use of the Site will include commercial, golf course, historical, industrial, and open space use. Commercial use will include development of offices and retail businesses, and will comprise approximately 636 acres of the Site. Most of the soil in commercial areas will be covered by buildings, parking lots, and roads. The remaining soil will be either professionally landscaped or covered with sidewalks. A golf course will cover approximately 187 acres of the Site. Historical areas on the Site include the 1833 Hudson's Bay Fort, the Shell Midden Site, the 404 Burial Site, and the Methodist Mission site (specific location is unkown). In total, the 1833 Fort, the Shell Midden, and the 404 site historical areas comprise approximately 6 acres of the Site. Industrial use may include activities ranging from

mining gravel to development of light industrial facilities. The area proposed for industrial use is north of Sequalitchew Creek and comprises approximately 36 acres of the Site. Open space use, which will occur in four areas of the Site, will encompass a total area of approximately 73 acres. The location of each of these future use areas is presented in Figure ES-2.

ES.3.2 Identification of Evaluation Units

The next step in the RA was identification of EUs. The EUs were developed based on the future Site uses described above, and were approved by Ecology. Future land use areas, such as the historical and open space areas, that were relatively small in size were evaluated without further division. The industrial land use area was also not divided. The commercial and golf course land use areas were divided into smaller EUs such that the smaller EUs were similar in size, consisted of contiguous property, and accounted for potential remedial alternatives. The RA EUs are presented in Figure ES-2.

ES.3.3 Media of Concern

Potentially affected media at the Site include surface soil (0-1 foot below ground surface [BGS]), subsurface soil (1 foot to 15 BGS), subsurface soil greater than 15 feet BGS, surface water (Old Fort Lake and Sequalitchew Creek), sediment (Old Fort Lake and Sequalitchew Creek), and groundwater. Based on the historical RI, preliminary and draft RAs, and ecological evaluations, it was determined that levels of COPCs in surface water and sediment were not of concern for protection of human and ecological receptors. Therefore, Ecology determined that no further action was warranted for these media (for more details see the current RI Report). In groundwater, DNT levels were slightly elevated above applicable groundwater standards.

ES.3.4 Preliminary Screening of COPCs

In the final step of this task, a preliminary list of COPCs was identified for further evaluation in the RA. This screening was conducted on a Site-wide basis (i.e., EUs were not screened individually in this step). In the initial screening step, sample results for all constituents were reviewed, and those constituents that were not detected in any samples were eliminated from further consideration. Following this screening step there were 38 detected constituents in surface soil and 52 detected constituents in subsurface soil >1 foot and $\leq$ 15 feet BGS, and 35 detected constituents in subsurface soil > 15 feet BGS.

In the last screening step, the maximum detected concentration for each constituent was compared to the most conservative (i.e., the lowest) soil cleanup levels and screening concentrations found in MTCA for the protection of groundwater, human health and ecological receptors. Following this screening step, there were 18 COPCs identified for surface soil and 19 COPCs identified for subsurface soil, and 3 COPCs identified for subsurface soil greater than 15 feet BGS. Constituents that did not have available risk-based screening concentrations were retained for further evaluation in the risk assessment. Soil samples analyzed for oil and grease were excluded from the RA due to the non-specificity of the analysis method, which measures both natural oils and greases and petroleum constituents.

ES.4 Identification of Soil Cleanup Levels and Remediation Levels

In this task, soil cleanup levels and remediation levels that are used to characterize potential impacts to human health and the environment, were identified. In addition, an area-specific background arsenic level was derived because the area background concentration is higher than MTCA soil cleanup levels. As previously mentioned, Ecology has determined that, with the exception of groundwater and soil, all media within the Consent Decree Boundary require “No Further Action”. Therefore, the cleanup levels and remediation levels identified were specific to soil. The presence of low levels of DNT in groundwater is addressed in the FS.

ES.4.1 Soil Cleanup Levels

Cleanup levels for soil are published in tables by Ecology, and are default values that can be used at any site. The only area on Site where these default cleanup levels apply is the industrial area located north of Sequalitchew Creek. These levels assume adult workers would be exposed to hazardous constituents through incidental soil ingestion, and were calculated using the algorithm and default exposure

assumptions identified in WAC 173-340-745. The other cleanup level used was 2,000 mg/kg for total petroleum hydrocarbons (TPH/diesel or heavier oils), which was taken from the MTCA Method A Table, in WAC 173-340-900. In addition, Site-specific cleanup levels for mercury, TPH (bunker C), total 2,4-dinitrotoluene and 2,6-dinitrotoluene (DNT), and 2,4,6-trinitrotoluene (TNT) were approved for use at the Site by Ecology (See Appendix C).

ES.4.2 Soil Remediation Levels

Soil remediation levels are site-specific levels based on protection of human health that are developed using exposure assumptions and other media-specific factors that reflect future site conditions. Remediation levels are calculated using human health risk assessment procedures and site-specific information, as specified in WAC 173-340-708. In order to apply remediation levels to site cleanup decisions, institutional controls (such as deed restrictions) are placed on properties with residual contamination to ensure that the exposure conditions applied to the derivation of these levels are maintained at the site in the future. Remediation levels were calculated for all constituents detected in at least one soil sample, unless the constituent did not have available toxicity information and was not directly linked to historical site operations.

The equations used to calculate remediation levels for all constituents except lead were obtained from WAC 173-340-740. Soil remediation levels were calculated using these equations, considering the potential reasonable maximum exposure (RME) for humans under each proposed land use with the exception of industrial use (for industrial use, MTCA default industrial cleanup levels were used, as described above). For lead, EPA has chosen to evaluate the potential adverse health effects using a physiologically-based model. The model currently used by EPA for establishing lead remediation levels in non-residential areas is the Adult Lead Model (EPA, 1996b). Using this model, site-specific remediation levels were developed for golf course worker, commercial landscape worker, and industrial worker scenarios. A hybrid approach using both the Adult Lead Model and the child Integrated Exposure Uptake Biokinetic Model for Lead (IEUBK), was used to derive a remediation level for open space areas.

ES.4.3 Ecological Soil Screening Concentration for Lead

Ecology has performed an evaluation of the Site and determined that lead is the indicator constituent for potential terrestrial ecological impacts. As part of this evaluation, Ecology determined that based on Site-specific information the potential species groups of concern included ground-feeding birds and herbivorous small mammals. The screening level identified by Ecology is 118 mg/kg and is intended to be protective of wildlife, including birds and small mammals. Exceedance of this value does not necessarily indicate that cleanup must occur, but that various other options could be explored to demonstrate that lead does not pose a threat to ecological receptors at the Site.

ES.4.4 Determination of Arsenic Background Level in Soil

In addition to the cleanup levels and remediation levels, an area background soil concentration was calculated for arsenic. As part of the RI investigation, soil samples were collected outside of the Consent Decree boundary to define the "Site Area Background" level of arsenic. As stipulated in WAC 173-340-709, twenty soil samples were collected to statistically establish area background levels. Based on the results of these samples, the site area background concentration for arsenic is 32 mg/kg. This value represents the 90^{th} percentile value of the distribution of the background samples.

A summary of the cleanup levels and remediation levels used for each future use scenario is presented in Table ES-1.

ES.5 Comparison of Site Soil Concentrations to Cleanup Levels and Remediation Levels

In this last task of the RA, soil concentrations for each EU were compared to the cleanup levels and remediation levels identified above. Only those COPCs that were detected in at least one sample and that had maximum concentrations that exceeded conservative risk-based screening criteria were evaluated in this task of the risk assessment.

The steps involved in this comparison included calculating the MTCA 95% Upper Confidence Limit (UCL) of the mean concentration (i.e., a conservative estimate of the mean) for each EU, comparing this concentration and the maximum detected concentration in each EU to cleanup standards applicable to the future use of each EU, and identifying EUs with COPC concentrations that do not comply with MTCA's Three-Fold Criteria [WAC 173-340-740 (7)(c),(d), and (e)]. In addition to the Three-Fold Criteria, constituents in each EU were also compared to MTCA's risk-based criteria.

ES.5.1 Comparison of EU Soil Concentrations to Cleanup Levels and Remediation Levels

The soil concentrations in each EU were compared to the cleanup standards to determine if the concentrations of COPCs in each EU comply with MTCA Three-Fold Criteria. The MTCA Three-Fold Criteria are the following:

1. The maximum soil concentration must be less than or equal to 2 times the site-specific cleanup level or remediation level.
2. The MTCA 95% UCL on the mean must be less than the site-specific cleanup level or remediation level.
3. Less than 10% of individual soil concentrations shall exceed the site-specific cleanup level or remediation level.

If any of these criteria are not met, then the EU is not in compliance, and was designated for evaluation in the FS.

ES.5.2 Comparison of EU Constituent Concentrations to MTCA Risk-Based Criteria

MTCA identifies risk-based criteria for constituents as follows:

1. The human health risk level for individual constituents may not exceed a hazard quotient of 1 or a cancer risk of one-in-a-million (1E-06) for historical, open space, golf course, and commercial EUs. The human health risk level for individual constituents may not exceed a hazard quotient of 1 or a cancer risk of one-in-one-hundred thousand (1E-05) for the industrial EU.
2. The total risk level at the site, based on cumulative exposure to all constituents, may not exceed a hazard index of 1 or a cancer risk of 1 in 100,000 (1E-05).

If an EU exceeds these criteria the EU does not comply with MTCA, and is carried through to the FS.

ES.5.3 Identification of EUs With COPCs in Soil That Exceed MTCA Three-Fold Criteria and/or MTCA Risk-Based Criteria

Each EU was evaluated using the MTCA Three-Fold Criteria and Risk-Based Criteria. Based on the results of this evaluation, the EU was determined to be in compliance or not in compliance with MTCA. The results of this evaluation are summarized below organized by future land use category.

ES.5.4 Commercial Land Use EUs

All commercial EUs were out of compliance with the MTCA Three-Fold Criteria and the Risk-Based Criteria. Arsenic and lead were the COPCs that exceeded the criteria most frequently.

ES.5.5 Golf Course Use EUs

All golf course EUs were out of compliance with the MTCA Three-Fold Criteria and the Risk-Based Criteria. Arsenic and lead were the COPCs that exceeded the criteria most frequently.

ES.5.6 Historical Use EUs

All historical EUs were out of compliance with the MTCA Three-Fold Criteria and the Risk-Based Criteria. Arsenic and lead were the COPCs that exceeded the criteria most frequently.

ES.5.7 Industrial Use EUs

There is only one industrial EU, which was in compliance with both the MTCA Three-Fold Criteria and the Risk-Based Criteria. There are a few instances though, where the soil concentrations exceed the soil-to-groundwater screening criteria.

ES.5.8 Open Space Use EUs

All open space EUs were out of compliance with the MTCA Three-Fold Criteria and the Risk-Based Criteria. Arsenic and lead were the COPCs that exceeded the criteria most frequently

ES.5.9 Summary of Results

All EUs were screened against MTCA's Three-Fold Criteria and Risk-Based Criteria. Using these criteria, all EUs except the industrial EU did not comply, and will require evaluation in the FS. Most criteria exceedances were noted in the surface soil samples. Arsenic and lead were the constituents responsible for almost all criteria exceedances in the EUs.

Table ES-2 presents a summary of the compliance status of each EU. Figures ES-3 and ES-4 present the EUs that did not comply with MTCA Three-Fold criteria and Risk-Based Criteria.

Table ES-1 – Soil Cleanup Levels and Remediation Levels Used for Evaluating EUs

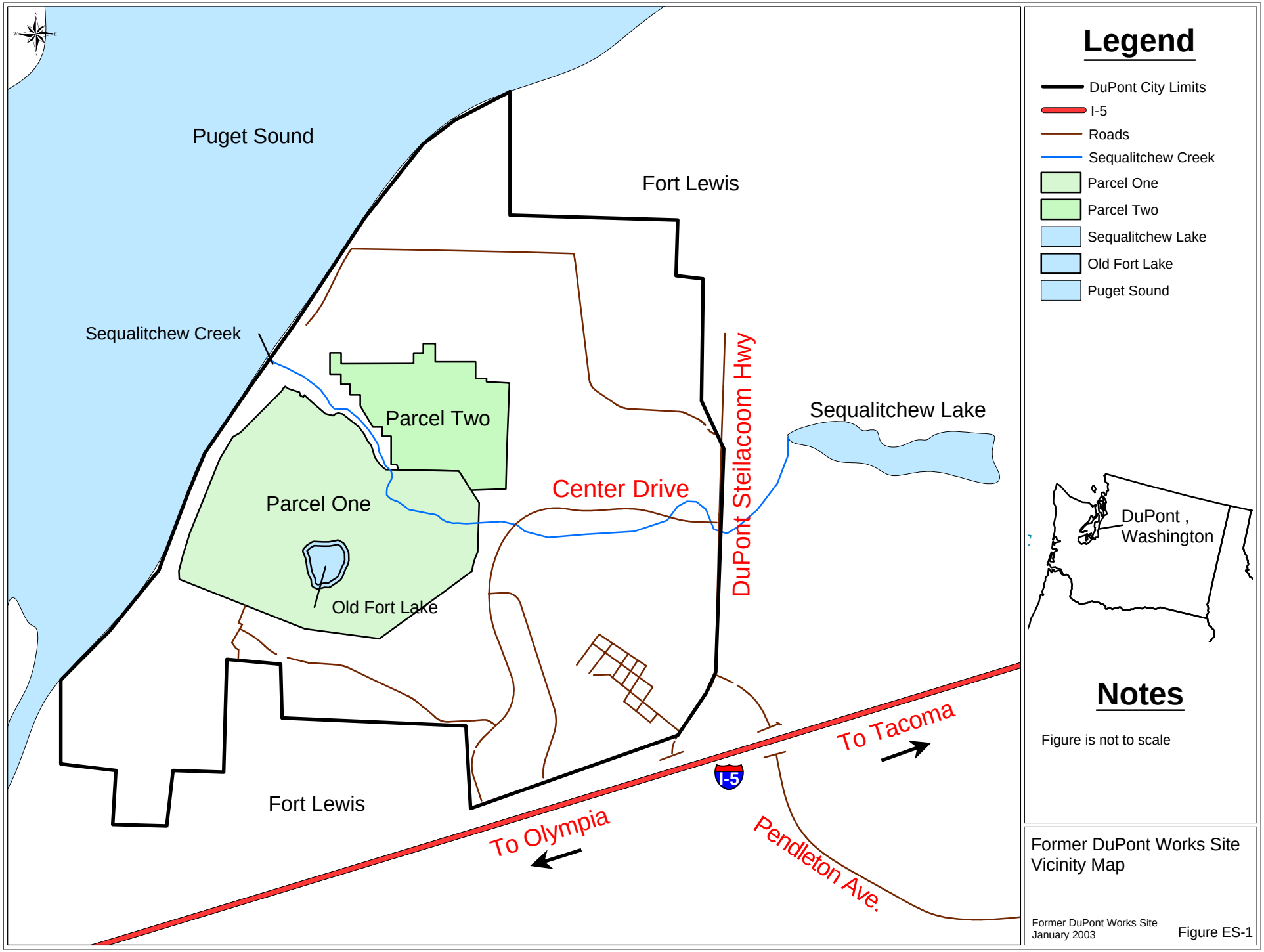
Constituent	Commercial and Golf Course EU Cleanup and Remediation Levels (mg/kg)	Historical and Open Space EU Cleanup and Remediation Levels (mg/kg)	Industrial EU Cleanup Levels (mg/kg)
Explosives			
Monomethylamine Nitrate	19,900[(1)]	6,680[(1)]	28,350
Nitroglycerine	6,580[(1)]	368[(1)]	4,080
2,4,6-Trinitrotoluene	1.75[(2)]	1.75[(2)]	1.75[(2)]
Petroleum Hydrocarbons			
TPH (418.1)	7,600[(2)]	7,600[(4)]	7,600[(2)]
Inorganics			
Aluminum	NC	825,000[(1)]	NC
Arsenic	60[(2)]	32[(2)]	90[(2)]
Copper	90,900[(1)]	30,500[(1)]	130,000
Lead	118[(3)]	118[(3)]	1,000[(5)]
Mercury	24[(2)]	24[(2)]	24[(2)]
PAHs			
Benzo(a)Anthracene	126[(1)]	7.1[(1)]	18
Benzo(a)Pyrene	12.6[(1)]	0.71[(1)]	18
Benzo(b)Fluoranthene	126[(1)]	7.1[(1)]	18
Benzo(k)Fluoranthene	1260[(1)]	71[(1)]	18
Chrysene	12,600[(1)]	710[(1)]	18
Dibenzo(a,h)Anthracene	12.6[(1)]	0.71[(1)]	18
Indeno(1,2,3-c,d)Pyrene	126[(1)]	7.1[(1)]	18
Pesticides/PCBs			
Aldrin	5[(1)]	0.3[(1)]	7.7

Notes:
NC = Not of Concern. Concentration calculated was equivalent to a 100 percent concentration. Therefore, this constituent is not of concern for this future land use.
Cleanup Levels are shaded and are either calculated using MTCA default parameters or measured site-specific information.
[(1)] Calculated using Site-specific parameters.
[(2)] Based on agreement with Ecology.
[(3)] Ecological screening concentration.
[(4)] Ecology agreement for TPH that originated as Bunker C fuel. One Area has TPH that did not originate from Bunker C fuel. Those TPH data were compared to the MTCA Table A value of 2,000 mg/kg for heavy oils.

[(5)] MTCA default value used for Parcel 2.

Table ES-2 – Summary of EUs to be Evaluated in the FS

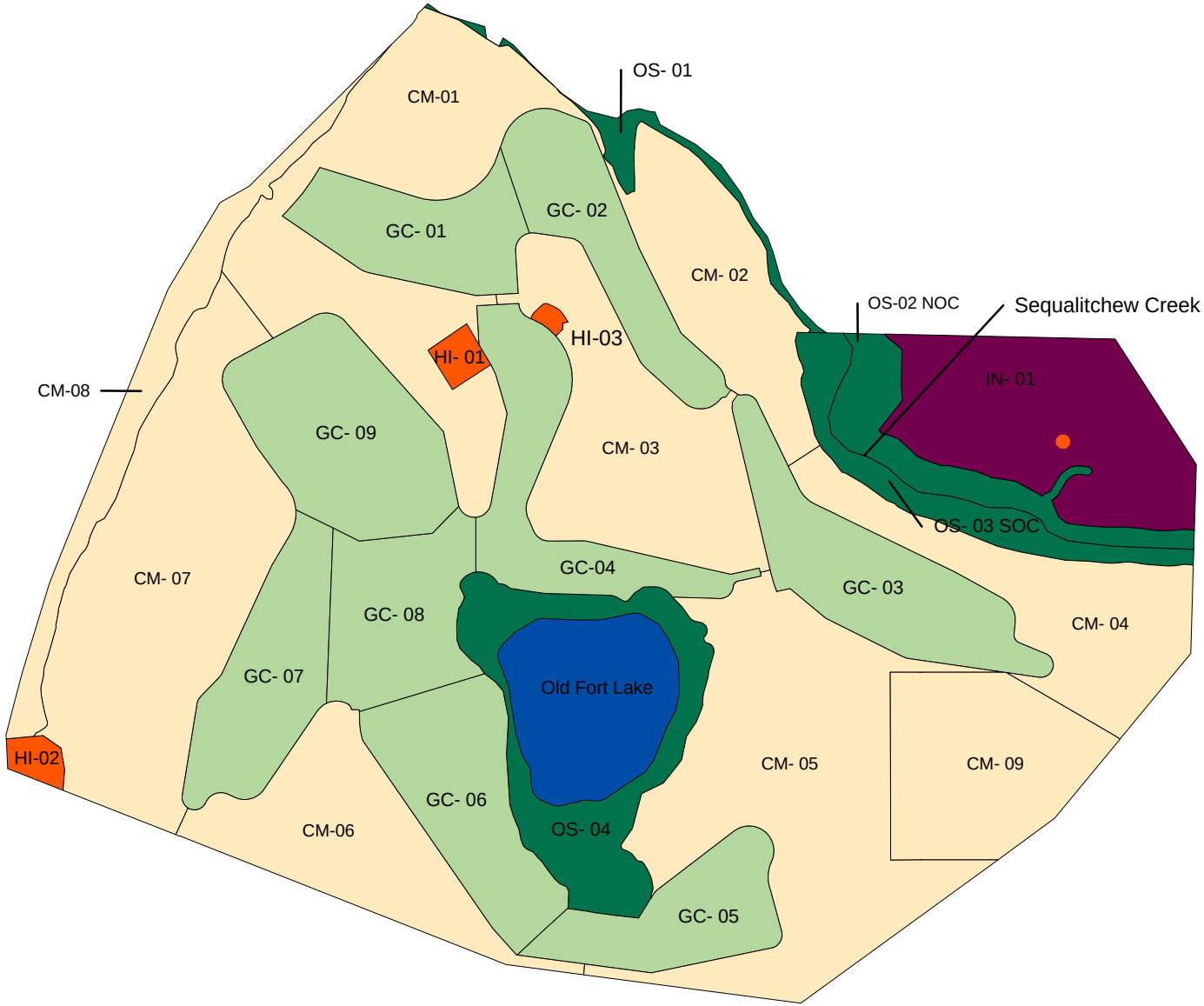
EU	EU to be Evaluated in FS
Commercial 1	Yes
Commercial 2	Yes
Commercial 3	Yes
Commercial 4	Yes
Commercial 5	Yes
Commercial 6	Yes
Commercial 7	Yes
Commercial 8	Yes
Commercial 9	Yes
Golf Course 1	Yes
Golf Course 2	Yes
Golf Course 3	Yes
Golf Course 4	Yes
Golf Course 5	Yes
Golf Course 6	Yes
Golf Course 7	Yes
Golf Course 8	Yes
Golf Course 9	Yes
Industrial 1	Yes
Open Space 1	Yes
Open Space 2	Yes
Open Space 3	Yes
Open Space 4	Yes
Historical 1	Yes
Historical 2	Yes
Historical 3	Yes



Former DuPont Works Site
Vicinity Map

Former DuPont Works Site
January 2003

Figure ES-1



0 250 500 1,000 1,500 2,000 Feet

PIONEER TECHNOLOGIES CORPORATION

Legend

- Golf Course
- Historical
- Industrial
- Open Space
- Old Fort Lake
- Commercial

Notes

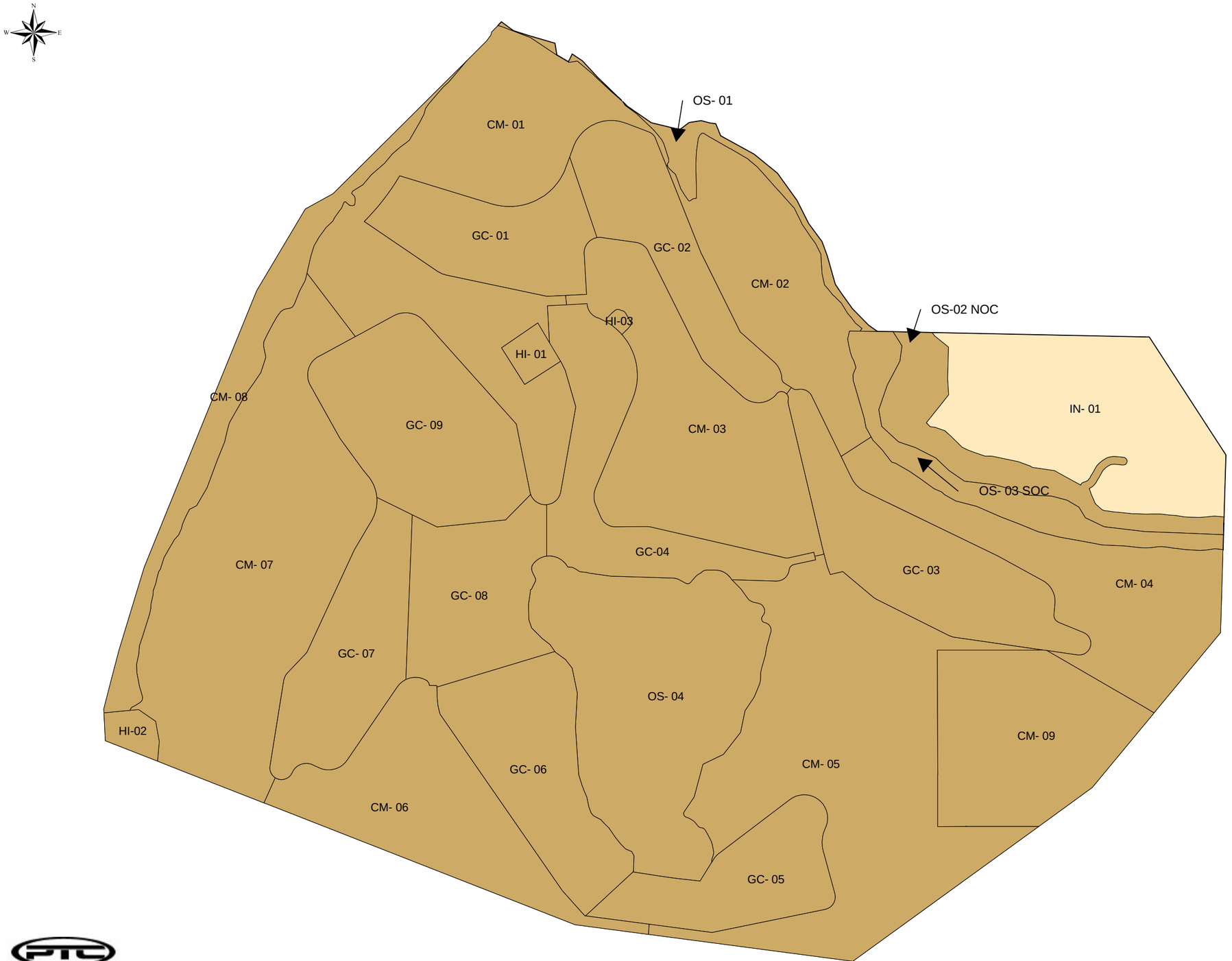
GC - Golf Course
HI - Historical
CM - Commercial
OS - Open Space
NOC - North of Creek
SOC - South of Creek

Historical location in the Industrial area is the Methodist Mission Marker. Actual location of the mission is unknown.

Risk Assessment Evaluation Units

Former DuPont Works Site
July, 2003

Figure ES-2



PIONEER TECHNOLOGIES CORPORATION

Legend

- Eu in Compliance 0 to <1 ft
- EU not in Compliance 0 to <1 ft

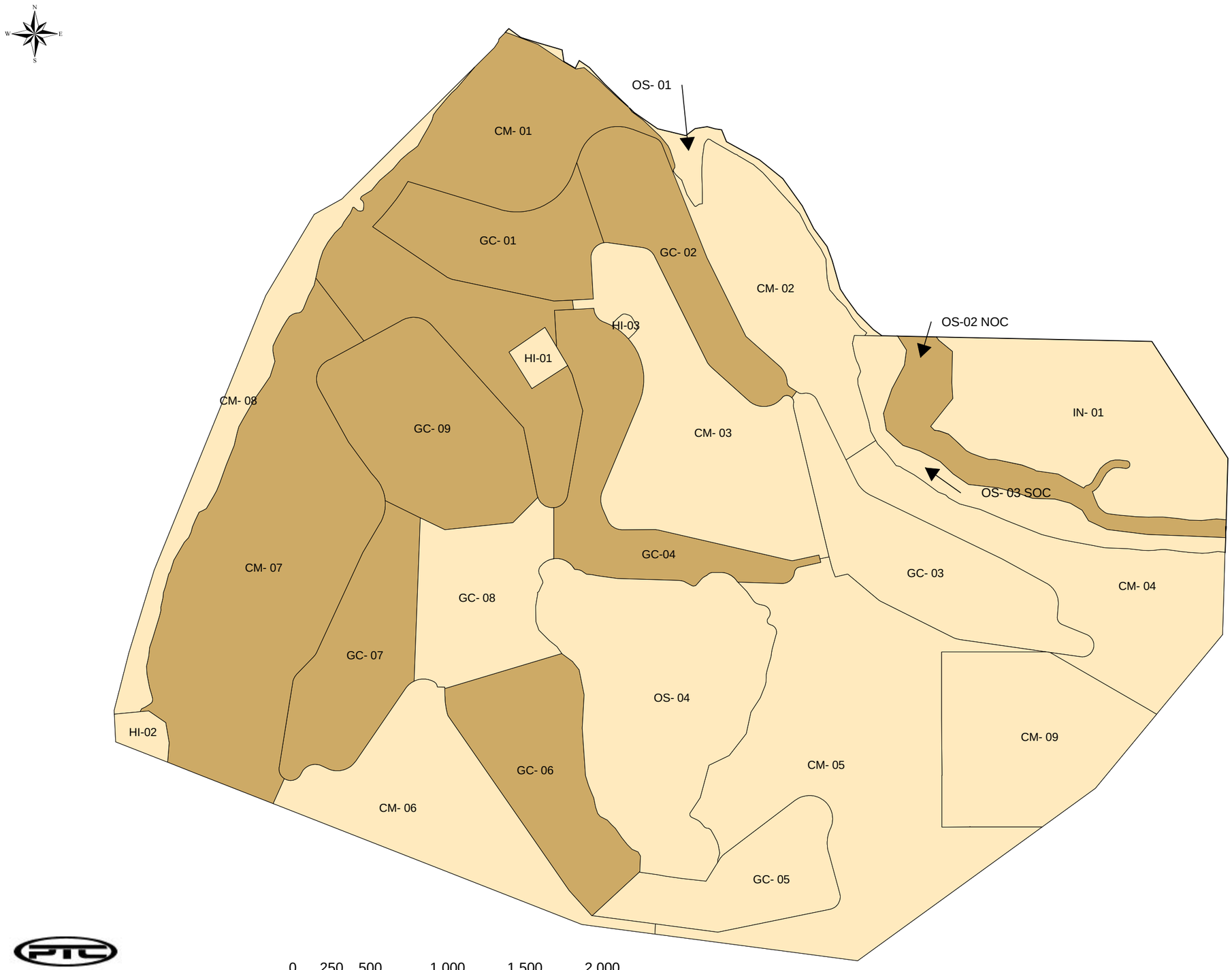
Notes

GC - Golf Course
CM - Commercial
HI - Historical
OS - Open Space
NOC - North of Creek
SOC - South of Creek
IN - Industrial

EU Compliance Status for Arsenic and Lead in Surface Soil

Former DuPont Works Site
September, 2002

Figure ES-3



PIONEER TECHNOLOGIES CORPORATION

Legend

- Eu in Compliance >1 to <15 ft
- EU not in Compliance >1 to <15 ft

Notes

GC - Golf Course
CM - Commercial
HI - Historical
OS - Open Space
NOC - North of Creek
SOC - South of Creek
IN - Industrial

EU Compliance Status for Arsenic and Lead in Subsurface Soil

Former DuPont Works Site
September, 2002

Figure ES-4